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UV SCATTERING FIELD RADIATION IN HEAVY METALS IN CONDITIONS OF NON NEUTRAL PLASMA

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ABSTRACT

Using the quantum model of electrodynamics near field, In the present work, the probability of dispersion of UV photons generated by a distribution of non-neutral plasma in a discharge chamber when they interact with a sample of air contaminated with heavy metals is determined experimentally. This technique aims to determine the degree of contamination by metals suspended in the environment, specifically in the Candelaria area of Bogotá.

KEYWORDS: Electromagnetic Fields, Electrical Conductivity, Hamilton Operator, Electric Permittivity & Voltage

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Original Article

INTRODUCTION

In the near-field quantum electrodynamics model, the electromagnetic configuration of the E and B fields in the Debye sphere [1], generated by a non-neutral plasma of frequencies(2 – 10).1016 Hz, doing a transformation in reciprocal space. This approach should lead to the calculation of the fine structure of the spectral lines of the dispersion photon UV by a heavy metals present in a sample obtained in a walking area of La Candelaria in Bogotá.

THEORETICAL MODEL

For the problem of the electromagnetic near field, the interaction Hamiltonian between settings high frequency plasma and a nanoparticle (NP)probably suspended in an air sample is presented as [2]:

$$\hat{H}_j = \frac{1}{2m}\left(\hat{p}_j - \frac{e}{c}\hat{A}_j\right)^2 + eEx_j - \mu B \tag{1}$$

Where: e – is electrical charge representing the electron; $\hat{p}_j$ –is operator impulse; μ - magnetic moment of NP; B –magnetic field generated by the plasma; $\frac{e}{c}\hat{A}_j$ - operator defines the magnetic impulse of the system.

Developing the calculation for the Hamilton operator of equation (1) in the model of Feynman path integrals, an approximate expression is obtained for the matrix element:

$$\langle x_{j+1}|p_j A_j|x_j\rangle = e^{-\frac{i}{\hbar}\tau U^*}\frac{A_j}{h}\int p_j dp_j e^{-\frac{i}{\hbar}p_j^2\frac{\tau}{2m}+\frac{i}{\hbar}\frac{e}{mc}p_j A_j \tau} \tag{2}$$

Where the function:

$$U^* = \frac{1}{2m}\left(\frac{e}{c}A_j\right)^2 + eEx_j - \mu B \tag{3}$$

In the proposed model reciprocal space, by solving the equation (2), the function that describes the radiation in the Debye sphere is:

$$f(k) = \sum_{j=1}^{n}\left(\frac{a_{j+1}j(j+1)+\alpha a_{j-1}}{\beta}\right)k_j \tag{4}$$

Where: $\alpha = \frac{2m\mu B}{\hbar^2}$; $\beta = \frac{2meE}{\hbar^2}$; k_j – representation in reciprocal space of the invert vector position.

The function described by the equation (4) becomes zero if the condition is achieved:

$$\alpha = -\frac{a_{j+1}j(j+1)}{a_{j-1}} \tag{5}$$

It is representing the magnetic moment of the system: $\mu = -\frac{\hbar^2}{2mB}\frac{a_{j+1}j(j+1)}{a_{j-1}}$

This last mathematical expression leads to the calculation of the length of radiation in the sphere of Debye as:

$$a_o = \frac{C_j}{\lambda_{UV}} \tag{6}$$

Where: C_j – conversion constant to the reciprocal space, which determines the boundary conditions.

Finally, the scattering UV cross section in non-neutral plasma with any heavy metals is [3]:

$$\sigma_j = \frac{1}{N_p a_o} \tag{7}$$

Where: N_p– number of particles (atoms – ions) in a discharge chamber.

EXPERIMENTAL PROCEDURE (Applied Technique)

For the experimental development of this work, a plasma chamber was designed with a system magnets ND incorporated, allowing focus the plasma in a region of radius of approximately 3 cm, around of the electrodes connected to the variable AC source (figure 1).

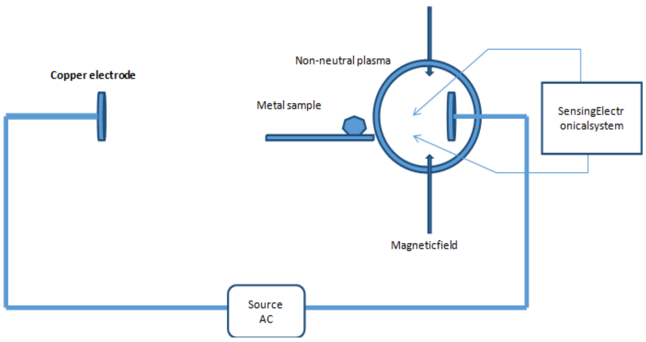

Figure 1: Schematic Representation of the Interaction of Non-Neutral Plasma with a Nanoparticle (NP) Probably Suspended in an Air Sample

The electronic measuring system configured to register simultaneously, voltage into the plasma, frequency, vacuum pressure, internal temperature in the chamber and the UV radiation.

Samples of leaves chosen and processed for experimental tests were previously isolated from unnatural contaminants to make the UV absorption measurement results reliable. Each sample collected was subjected to the direct action of the electromagnetic field generated by the plasma configuration in the test chamber high frequency $(2 – 10).10^{16}$ Hz.

Following, we register and analyse the data obtained from current, voltage and UV radiation. One of the biggest problems encountered in the research process was that the lifetime of the sensors conditioned in the camera was relatively low, less than an hour, for this reason was necessary to make a frequency divisor, but it's with the drawback of the signal that we watched in the oscilloscope was asymmetric. Once the sensors of the high field voltage were protected, the results obtained in the absorption process were filtered and registered in a database for further analysis.

ANALYSIS OF RESULTS

In the mathematical approach was established the criterion of the hyperbolic configuration of the dipoles in the network of plant tissue, responsible for the absorption and re-emission of UV photons and therefore determining the electrical conductivity leading to the establishment of a differential equation of variable coefficients known as Riccati equation, It implied that the distribution of local function in the structure has the same hyperbolic configuration.

However, the presumption of an exponential configuration of the dipoles in the network is a closer way of mathematical solution and according to the experimental results obtained in the process type diffusion length L_n, L_p. [4]. This in turn makes the simulation model that determines the interaction of the UV photon with an NPM on the surface of a sample easier to solve.

Experimental Data of UV Scattering in a Gas Sample

In the figures 1, 2, we presented the experimental data of the scattering process of electromagnetic radiation in a sample of air in the IR and UV bands, while in the figure 3, 4 we show the same process in a sample gas with NPMs. In the simulation model used, near field theories, the quantum function that describes the frequency of the radius in the Debye sphere, the anomalous interaction of UV radiation with the plant tissue samples could be observed. In this same route, it was possible to obtain the distribution model of the load carriers, by avalanche, generated by the presence of an NPM on the surface of the samples, that dependent of the electric potential gradient in the sample, while in other areas damming thereof produced by the electric field it is generated, sensitive to variations in structure, and which together create locally a thermal gradient.

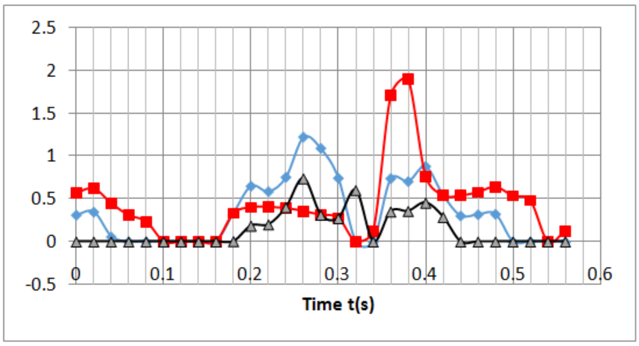

Figure 1: Experimental Data Obtained for an Air Sample in the IR Band. The Red Line is the Magnetic Field, the Blue Line is the IR Radiation and the Black Line is the Voltage Behaviour in a Discharge Chamber

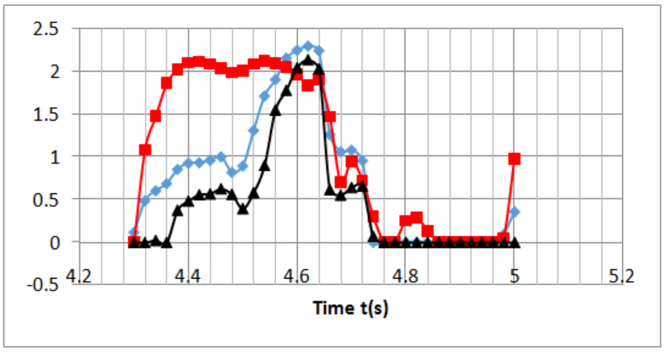

Figure 2: Experimental Data Obtained for a Sample of Air in the UV Band. The Red Line is the Magnetic Field, the Blue Line is the UV Radiation and the Black Line is the Voltage Behaviour in a Discharge Chamber

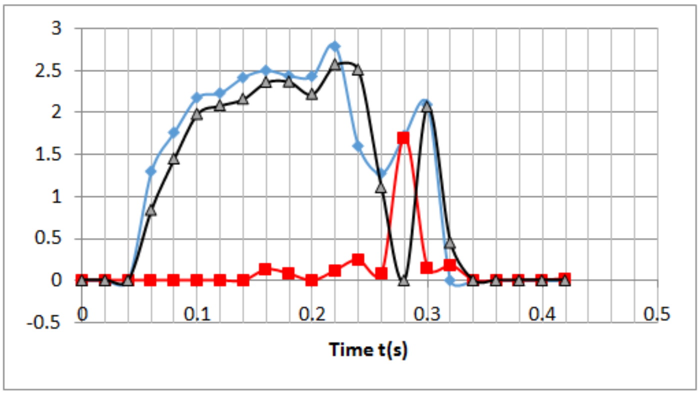

Figure 3: Experimental Data Obtained for an Air Sample with NPMs in the IR Band. The Red Line is the Magnetic Field, the Blue Line is the IR Radiation and the Black Line is the Voltage Behaviour in a Discharge Chamber

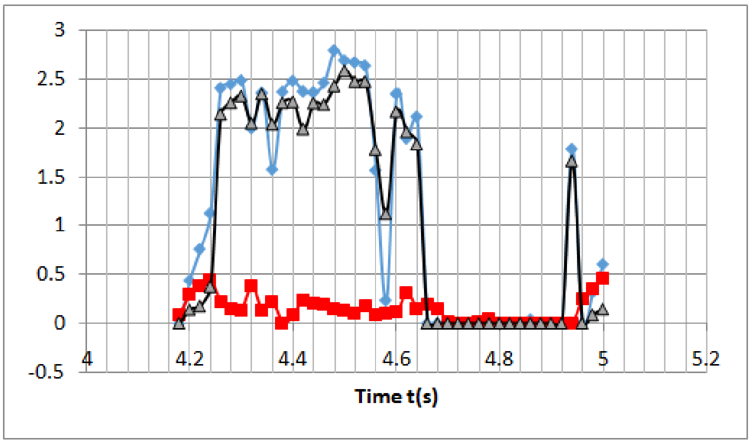

Figure 4: Experimental Data Obtained for a Sample of Air with NPMs in the UV Band. The Red Line is the Magnetic Field, the Blue Line is the UV Radiation and the Black Line is the Voltage Behaviour in a Discharge Chamber

DISCUSSION OF RESULTS

The proposed theoretical model of interaction of a NPM with plant tissue in the sphere Debye from a non-neutral plasma, became apparent the anisotropic behaviour of this radiation, due to the multiple effects of collision between

particles, tunneling effect particles in a gas and the temperature variation. Before the results are supported, each with a pair of calibration functions and the experimental results obtained, which were chosen taking into account the initial conditions of the problem and that met the dynamic equations of the behaviour of the internal current in the system.

CONCLUSIONS

- The anisotropy of the process of absorption of UV radiation in the Debye sphere for an NPM is strongly influenced by the energy states of the dipoles in the plant tissue network, therefore of the collapse of the wave functions describing the entire process. Moreover, to measure a UV signal into the plasma, gave thanks the quantum decoherence observable in the measurement.
- The above leads to improve the measurement system and to develop a series of multiple experimental tests primarily to determine with greater certainty the measurement, the UV response of the NPM vs plant tissue interaction is suggested to the configuration of the E and B fields in the plasma.
- The theoretical model proposed in the present work, gives an efficient account of the interaction process between an NPM and the network of dipoles in a sample of plant tissue, specifically express the influence of the relative humidity in a scattering UV process of the samplegas with NPMs, model that in other reports have not been found so far.

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